APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR		ATTORNEY DOCKET NO.
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EXAMINER
PADMANABHAN, M

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DATE MAILED:

01/18/00

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

☒ Responsive to communication(s) filed on _Dec 15, 1999_   .

☐ This action is **FINAL**.

☐ Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire ____3____ month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claims

☒ Claim(s) _1, 2, 6-9, 12-16, and 18-25_ _____ is/are pending in the application.

   Of the above, claim(s) _____ is/are withdrawn from consideration.

☐ Claim(s) _____ is/are allowed.

☒ Claim(s) _1, 2, 6-9, 12-16, and 18-25_ _____ is/are rejected.

☒ Claim(s) _12_ _____ is/are objected to.

☐ Claims _____ are subject to restriction or election requirement.

Application Papers

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on _____ is ☐approved ☐disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

   ☐ All ☐ Some* ☐None   of the CERTIFIED copies of the priority documents have been

      ☐ received.

      ☐ received in Application No. (Series Code/Serial Number) _____ .

      ☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   *Certified copies not received: _____ .

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

☐ Notice of References Cited, PTO-892

☐ Information Disclosure Statement(s), PTO-1449, Paper No(s). _____

☐ Interview Summary, PTO-413

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

--- SEE OFFICE ACTION ON THE FOLLOWING PAGES ---

DETAILED ACTION

Continued Prosecution Application

1.   The request filed on 12/15/99 for a Continued Prosecution Application (CPA) under 37

CFR 1.53(d) based on parent Application No. 08/845526 is acceptable and a CPA has been

established. An action on the CPA follows.

2.   Applicants response and amendments received at the office on 12/10/99 in response to

the office action mailed on 9/10/99 have been fully considered. The 103 rejections made in the

previous action are maintained for claims 1-2, 6-9, 12-16, and 18-25.

Status of claims

        Claims 1-2, 6-9, 12-16, and 18-25 are in the Application.

        Claims 3, 4, 5, 10, 11, and 17 have been canceled.

        Claims 1, 2, 6-9, 12-16, and 18-25 are rejected.

        Claim 12 is objected to.

Claim Objections

2.   Claim 12 is objected to under 37 CFR 1.75(c), as being of improper dependent form for

failing to further limit the subject matter of a previous claim. Applicant is required to cancel the

claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the

claim(s) in independent form.

Claim 12 adds to canceled claim 11 the limitation of using the plurality of points to

render the Bezier curve.

Claim Rejections - 35 USC § 112

3.   The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and
> distinctly claiming the subject matter which the applicant regards as his invention.

4.   Claim 12 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for

failing to particularly point out and distinctly claim the subject matter which applicant regards as

the invention.

Claim 12 adds to claim 11 the limitation of using the plurality of points to render the

Bezier curve. But claim 11 has been canceled applicant, and hence claim 12 is rendered

indefinite.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found

in a prior Office action.

5.   Claims 1-2, 6, 8, 13, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable

over *Jia et al*. (U.S. Patent Number 5,726,896) in view of *Gharachorloo et al* (U.S. Patent

Number 5,488,684), Luken, Jr. (U.S. Patent Number 5,278,948), and Schulmeiss (U.S. Patent

Number 5,717,847).

        In claim 1, the applicant lays claim to a computer system that implements the method of

receiving a NURBS model from a server, converting it to a Bezier model, generate a plurality of

control points on the Bezier curve from a plurality of NURBS control points using a tri-linear

interpolator in the graphics pipeline, using NURBS control points as input to the tri-linear

interpolator, and evaluating these points to generate Bezier control points and rendering the curve

using the graphics pipeline, **without first converting the NURBS defined curve or surface to a**

polygon mesh.

        Jia et al teach a method of converting a NURBS surface model to a Bezier surface model,

evaluating a plurality of NURBS control points into Bezier control points (Col.3: lines 32-37,

Col. 4: lines 38-45), and interpolating a plurality of control points (Col. 5: lines 1-5).   **Jia also**

teaches generating a curve without first converting the NURBS defined curve to a polygon

mesh (Fig.5). *Jia et al* fail to teach the use of tri-linear interpolator, and a method to receive the

data from the server (host processor) and rendering it. *Gharachorloo et al* teach a method to

receive data from a host processor into a graphics pipeline, and use the graphics pipeline to

render the object (refer Figs. 1, 2, 2A). Luken inherently teaches the use of tri-linear

interpolators by disclosing that the de Casteljau process performs a linear interpolation between

the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the

NURBS control points forming the input to these interpolators.   Schulmeiss discloses the use of

de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-22). Hence it would be

obvious to one skilled in the art at the time the invention was made to store the surface model

data in a host processor, and use this method to download the data as needed, and use a tri-linear

interpolator to generate the Bezier control points from NURBS control points as this would

ensure better utilization of system processing resources on the client, and provide high speed and

accuracy and enable velocity control to a given tolerance.

Claim 2 adds to claim 1 the step of receiving the NURBS surface model via the bus.

Gharachorloo et al teach a method to receive data using a bus (refer Fig. 1). Hence it

would be obvious to one skilled in the art at the time the invention was made to use a bus to

receive the NURBS model from a host processor, as it is an effective and dependable

communication medium.

Claim 6 adds to claim 1 the limitation of generating points on the curve using Bezier

control points.

Jia et al disclose the use of Bezier control points as input to the processor that determines

points on the curve (Col.3: lines 32-44).

Claim 8 adds to claim 1 the use of graphics rendering pipeline to render the curve or

surface.

Gharachorloo teaches the use of a Graphics pipeline (Fig. 1). Hence it would be obvious

to one skilled in the art at the time the invention was made to use a graphics pipeline to render

the curve as this would streamline the process, and accelerate the process of rendering the curve.

Claim 13 lays claim to a graphics rendering pipeline of a computer system that evaluates

the NURBS control points to a Bezier model using a tri-linear interpolator in the graphics

pipeline, generates a plurality of control points on the Bezier curve, and renders the curve.

Jia et al teach a method of loading a processor with the NURBS control points (Col.3:

lines 32-36), converting the NURBS surface model to a Bezier surface model (Col. 4: lines 38-

48), and determining a plurality of points on the Bezier curve. *Jia et al* fail to teach a method of

rendering the curve using a graphics pipeline. *Gharachorloo et al* teach a method of using the

graphics pipeline to render NURBS surfaces (Col.9: lines 64-67). Luken inherently teaches the

use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear

interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15:

lines 32-45), the NURBS control points forming the input to these interpolators. Schulmeiss

discloses the use of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-

22). Hence it would be obvious to one skilled in the art at the time the invention was made to

use a graphics pipeline to render the Bezier curve using the points derived by using the method as

described by Jia, as this would streamline the rendering process, and ensure better utilization of

system processing resources, and provide better control over velocity levels.

Claim 14 adds to claim 13 the limitation of using a tri-linear interpolator to evaluate the NURBS control points into Bezier control points.

Jia teaches the method of evaluating a plurality of NURBS control points into Bezier control points. Jia fails to teach the use of tri-linear interpolator, and the input of NURBS control points to the tri-linear interpolator. Schulmeiss discloses the use of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-22). Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Hence it is obvious to one skilled in the art at the time the invention was made to use a tri-linear interpolator to generate the Bezier control points since this will provide high speed and accuracy.

Claim 15 adds to claim 13 the step of transforming the NURBS curve or surface from a global domain to a local domain.

Gharachorloo teaches a method of transforming the NURBS surface model from a global memory to local memory (Col.2: line 58 - Col.3: line 10 & Col.14: lines 17-27). Hence it is obvious to one skilled in the art at the time the invention was made to use global to local transformation of the NURBS curve, as such a transformation can make better utilization of the available resources.

6.   Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over *Jia et al.* (U.S.

Patent Number 5,726,896) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684),

Luken, Jr. (U.S. Patent Number 5,278,948), and Schulmeiss (U.S. Patent Number 5,717,847) as

applied to claim 6, and further in view of Sherman et al. (U.S. Patent 5,734,756).

Claim 7 adds to claim 6 the limitation that the Bezier control points are input to a tri-

linear interpolator to generate points on the curve.

Jia et al disclose the use of Bezier control points as input to the processor that determines

points on the curve (Col.3: lines 32-44). Jia et al also teach that the Bezier curve is a special case

of the B-spline curve (Col.7: line 27). Jia et al fail to disclose the use of tri-linear interpolator.

Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau

process performs a linear interpolation between the components (x,y,z) of the control points

(Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these

interpolators. Sherman et al teach that Bezier curves are generally evaluated using a recursive

algorithm due to de Casteljau (Col.14: lines 32-35). Since Bezier curve is a special case of a

NURBS curve, it would be obvious to one skilled in the art at the time the invention was made to

input the Bezier control points to a tri-linear interpolator to generate points on the curve, as this

would improve system performance.

7.   Claims 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over *Luken, Jr.* (U.S.

Patent Number 5,278,948), *in view of Jia et al.* (U.S. Patent Number 5,726,896), *Sherman et al*

(U.S. Patent Number 5,734,756), and Schulmeiss (U.S. Patent Number 5,717,847).

Claim 9 lays claim to a method of rendering curves by evaluating a Bezier curve using de Casteljau process using a tri-linear interpolator in the graphics rendering pipeline, without first converting the NURBS defined curve or surface to a polygon mesh.

Luken teaches the use of Cox-DeBoor (or DeCasteljau) process for evaluating a b-spline curve (Col.15: lines 40-44). Luken also teaches the method of using a graphics pipeline (Col.28: lines 59-61), and the use of Cox-DeBoor process in the graphics processor for evaluation (Col.29: lines 5-10). Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Luken fails to teach the use of these methods for a Bezier curve. Jia et al also teach that the Bezier curve is a special case of the B-spline curve (Col.7: line 27). Sherman discloses that the de Casteljau process is a widely accepted method of evaluating Bezier curves (Col. 14: lines 32-35). **Schulmeiss discloses the use of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-22). Jia also teaches generating a curve without first converting the NURBS defined curve to a polygon mesh (Fig.5).** Hence it would be obvious to one skilled in the art at the time the invention was made to use the de Casteljau process, and a tri-linear interpolator in the graphics pipeline to evaluate and render a Bezier curve, since this would render the system faster.

4.   Claims 16, 18, and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Luken, Jr. (U.S. Patent Number 5,278,948) as applied to claim 16, in view of *Jia et al.* (U.S. Patent Number 5,726,896) and Schulmeiss (U.S. Patent Number 5,717,847).

Claim 16 lays claim to a method of generating normal vectors for a surface based on

generating surface partials using a tri-linear interpolator loaded with Bezier control points as

input, then generating surface tangents from these partials, and generating normals from these

tangents.

Luken inherently teaches the use of tri-linear interpolators by disclosing that the de

Casteljau process performs a linear interpolation between the components (x,y,z) of the control

points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to

these interpolators. Luken also teaches the use of interpolators for each component to derive the

surface partials (Col. 19: lines 18-25). Luken fails to teach the use of Bezier control points as

input to the tri-linear interpolator. Jia teaches the method of evaluating Bezier control points

(line 35-40). Jia also teaches that Bezier curve is a special case of a B-spline curve. Schulmeiss

discloses the use of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-

22). Hence it is obvious to one skilled in the art at the time the invention was made to use

Bezier control points as input to a tri-linear interpolator to generate surface partials, since Bezier

points are a subset of NURBS control points.

Claim 18 adds to claim 16 the step of generating the surface tangents from the surface

partials using a blender in the graphics pipeline.

Luken teaches the generation of surface tangents from surface partials for NURBS

surfaces (Col.9: lines 6-25). Luken fails to teach this for blending curves. Jia teaches that the

Bezier curves are a special case of B-splines, and also teaches the use of Bezier curves as

blending functions (Col. 7: lines 29-31). Hence it is obvious to one skilled in the art at the time

the invention was made to use such blending curves, since the shape approximation with NURBS

is not generally understood, and the NURBS can be exactly represented by a series of piecewise

Bezier curves.

Claim 19 adds to claim 18 the step of generating at least one normal from the surface

tangents.

Luken teaches the method of generating normals from surface tangents ((Col.9: lines 6-

25).

8.   Claims 20-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Luken, Jr.

(U.S. Patent Number 5,728,948) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684).

Claim 20 lays claim to a method of rendering a curve by doing a global to local

transformation, evaluating the NURBS control points using tri-linear interpolation, and rendering

the curve using the points thus created.

Luken teaches a method of evaluating NURBS control points to derive points on the

curve (Col.15: lines 40-45). Luken inherently teaches the use of tri-linear interpolators by

disclosing that the de Casteljau process performs a linear interpolation between the components

(x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points

forming the input to these interpolators. Luken fails to teach a transformation from global

domain to local domain. Gharachorloo teaches a method of transforming the NURBS surface

model from a global memory to local memory (Col.2: line 58 - Col.3: line 10 & Col.14: lines

17-27), rendering a NURBS curve. Hence it would be obvious to one skilled in the art at the

time the invention was made to use the transformation as taught by Gharachorloo so as to make

better utilization of the local resources.

        Claim 21 adds to claim 20 the step of indexing at least one look up table for performing

the transformation.

        Luken teaches the use of transformation matrix pre-loaded in memory in the graphics

control processor (Col.12: lines 18-20).

        Claim 22 adds to claim 21 the limitation of evaluating the NURBS control points using

tri-linear interpolator.

        Luken inherently teaches the use of tri-linear interpolators for evaluating the NURBS

control points, by disclosing that the de Casteljau process performs a linear interpolation between

the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45).

        Claim 23 adds to claim 22 the limitation of indexing the look up table to be able to

configure the tri-linear interpolator.

Luken teaches the use of transformation matrix pre-loaded in memory in the graphics

control processor (Col.12: lines 15-20), which is used to transform the x, y, z coordinates of the

control points.

Claim 24 adds to claim 23 the step of implementing a quadri-linear interpolator using tri-

linear interpolator, and generating control points.

Luken discloses the existence of NURBS control points with coordinates (wx,wy,wz,w),

and the evaluation of such control points by interpolation (Col.15: lines 32-46). This inherently

teaches quadri-linear interpolation.

9.   Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Luken, Jr. (U.S.

Patent Number 5,728,948) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684), and

further in view of Oha (U.S. Patent Number 5,202,670).

Claim 25 adds to claim 20 the use of convolution in the graphics pipeline to obtain points

on the curve.

Oha teaches the convolution of original data and interpolated function in the graphics

pipeline to derive a set of points on the curve (Col.15: lines 5-13). Hence it is obvious to one

skilled in the art at the time the invention was made to use convolution in order to achieve faster

processing of the control points.

Response to Arguments

10   Applicant's arguments filed on 12/10/99 have been fully considered but they are not

persuasive.   Applicants argue that Jia is concerned with spline interpolation for the control CNC.

It is being reiterated that the test for obviousness is not whether the features of a secondary

reference may be bodily incorporated into the structure of the primary reference; nor is it that the

claimed invention must be expressly suggested in any one or all of the references. Rather, the

test is what the combined teachings of the references would have suggested to those of ordinary

skill in the art. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981).   It is pointed out

that NURBS is a b-spline.

Conclusion

Any response to this correspondence should be mailed to:

Box AF

>   Commissioner of Patents and Trademarks

>   Washington, D.C. 20231

or faxed to:

>   (703) 305-9051, (for formal communications; please mark "EXPEDITED

>   PROCEDURE")

Or:

>   (703) 308-6606 (for informal or draft communications, please label

>   "PROPOSED" or "DRAFT")

Hand-delivered responses should be brought to Crystal Park II, 2021 Crystal

Drive, Arlington. VA., Sixth Floor (Receptionist).

Any inquiry concerning this communication or earlier communications from the examiner

should be directed to Mano Padmanabhan whose telephone number is (703) 306-2903. She can

normally be reached Monday-Thursday from 6:30am-5:00pm.

If attempts to reach the examiner are unsuccessful, the examiner's supervisor, Mark Powell,

can be reached on (703) 305-9703.

Any inquiry of a general nature or relating to the status of this application should be directed

to the Group receptionist whose telephone number is (703) 305-3900.

MARK K. ZIMMERMAN
PRIMARY EXAMINER

Mano Padmanabhan

January 13, 2000